On the Lunar Perturbations arising from the Planet Jupiter.

By E. Neison.

Shortly after the appearance of Professor Newcomb's paper "On a hitherto unnoticed Inequality in the Longitude of the Moon" (*Monthly Notices*, June 1876, p. 358), my attention was directed to a new term in the lunar longitude arising from the perturbing action of *Jupiter*, and having the value

$$-1''.0 \sin \{(2-2m_1-c)\, nt+f-2f_1+\mathrm{A}\}.$$

where $(nt+f)$ is the Moon's mean longitude; $(cnt+f-\mathrm{A})$ the Moon's mean anomaly; and $(m_1 nt+f_1)$ the mean longitude of *Jupiter*. This term agreed well in period with the inequality discovered by Professor Newcomb, and its coefficient was only a little smaller, but was stated to be merely approximate. Being at the time engaged in a similar branch of the lunar theory, I was led to examine this new term and to determine its value with some accuracy.

This term arises from a portion of the disturbing function of the Moon due to the planets, which has not been examined by Laplace, Plana, or Pontécoulant, nor apparently by Hansen, namely, that portion depending on the difference in longitude of the Moon and planet. It is in form analogous to the *evection*, and obtains its sensible value from the approach to equality between the periods of the revolution of the Moon's perigee and of the orbital revolution of the planet *Jupiter*. This fact at once directed my attention to the associated inequality of long period whose argument is—

$$\{(2-2m_1-2c)\, nt-2f_1+2\mathrm{A}\},$$

the value of which is still more dependent on the periods of the revolution of the Moon's perigee and the orbital revolution of the disturbing body.

In the ordinary lunar perturbations arising from the disturbing action of the Sun, the value of the inequality of long period is less than one-twentieth of the associated inequality of short period, because the period of the revolution of the Moon's perigee is nine times as great as the period of the apparent motion of the Sun. In the perturbations due to the disturbing action of the planet *Jupiter*, as the period of the revolution of the Moon's perigee is nearly four-fifths of the period of the revolution of the planet in its orbit, from the much closer approach to equality between the two periods, it is very probable that the inequality of long period would be almost as great as the associated inequality of short period.

The determination of the accurate values of these two terms with algebraical coefficients was found to be a work of unexpected difficulty and much labour. These and similar terms due to *Jupiter* rise by two orders on integration. As the ordinary

lunar perturbations only converge by the same amount for each power of the disturbing force of the Sun, it is necessary to take into consideration the fourth power of the disturbing force of the Sun together with the first power of the disturbing force of *Jupiter*. After satisfying myself that both inequalities possessed a sensible value in comparison with the other inequalities arising from the action of the planets, the task of completely determining the value of these terms was postponed until the completion of my new Tables of the general development of the higher powers of the disturbing forces in the lunar theory.

These Tables have been now finished sufficiently to enable them being used to compute the value of these two inequalities, a work now of comparatively small trouble and difficulty; and the algebraical coefficients obtained, which are lengthy, have been reduced to numbers. The results are—

$$\delta r = -0''{\cdot}493 \cos\{(2-2m_1-c)nt+f-2f_1+\mathrm{A}\} + 0''{\cdot}001 \cos\{(2-2m_1-2c)nt-2f_1+2\mathrm{A}\}.$$

$$\delta v = -0''{\cdot}990 \sin\{(2-2m_1-c)nt+f-2f_1+\mathrm{A}\} + 1''{\cdot}513 \sin\{(2-2m_1-2c)nt-2f_1+2\mathrm{A}\}.$$

It is of course only in the longitude that these terms could become sensible. The labour in properly computing the value of these terms is shown by the fact that it cannot properly be done unless over twenty similar terms have had their values previously ascertained.

These two new terms derive additional interest from the fact that they are the first terms derived from the second portion of the disturbing force of the planets which have been found to possess sensible coefficients. They, moreover, have considerably larger values than any other inequalities due to *Jupiter*.

Corrections to the Nautical Almanac Places of the Moon for Longitude Observations in connection with the Transit of Venus 1874. By Captain G. L. Tupman.

(*Communicated by the Astronomer Royal.*)

These corrections have been deduced entirely from observations at places which have been connected by galvanic signals with the Royal Observatory, Greenwich, for longitude, and where both limbs of the Moon were equally observed, viz.:—

1° of both elements at Greenwich, with the Transit-Circle and Altazimuth, between 1874, Sept. 15, and 1875, Feb. 23.

2° of both elements at Paris, between 1874, Sept. 14, and 1875, Feb. 22, including those made with the Gambey instruments, published in *Comptes Rendus* 1875, May 24.